REMARKS

In response to the objection to the Abstract of the Disclosure set forth in item 15 on page 2 of the Office Action, Applicants have amended the language of the Abstract to eliminate the word "comprises". A copy of the revised Abstract is attached hereto on a separate sheet, as required.

Claims 14 and 16 have been rejected under 35 U.S.C. §112, second paragraph, for failing to particularly point out and distinctly claim the invention, based on certain formal issues identified by the Examiner in item 16 of the Office Action. In response to this ground of rejection, Claims 14 and 16 have been amended in a manner which addresses and is believed to resolve the formal issues cited by the Examiner. Accordingly, reconsideration and withdrawal of these grounds of rejection are respectfully requested.

Claims 11-14, 21 and 24 have been rejected under 35 U.S.C. §103(a) as unpatentable over Strasser et al (U.S. Patent No. 6,134,881) in view of Haidn et al (U.S. Patent No. 6,151,887). In addition, Claims 17-20, 22, 23 and 25-29 have been rejected as unpatentable over Strasser et al in view of Tuffias et al (U.S. Patent No. 5,855,828). However, for the reasons set forth hereinafter, Applicants respectfully submit that all claims which remain of record in this application

distinguish over the cited references, whether considered separately or in combination.

The present invention is directed to a method of manufacturing a combustion chamber for a rocket drive which includes at least one jacket made of a composite material with a ceramic matrix, in which the composite material contains a fibrous structure made of carbon-containing fibers. According to a feature of the invention, the fibrous structure consists of layers of fibers forming a three-dimensional matrix. In particular, the fibrous structure includes three layers, with the fibers of the first layers extending in a first direction in space, the fibers of the second layers extending in the second direction in space, and the fibers of the third layers extending in a third direction in space, with the individual layers penetrating each other at least partially. In order to achieve such a structure, during formation of the fibrous structure, the fibers or bundles of fibers of each layer are separated from each other, so that fibers or bundles of fibers of another layer, extending in another direction in space, can be disposed in the resulting spaces. This feature permits mutual interpenetration of the individual layers, as mentioned previously.

According to another embodiment of the invention, as recited in Claims 23-26, the combustion chamber includes both a first jacket made of a ceramic matrix composite material, and a load-bearing external jacket affixed thereon. Claim 23, in particular, recites a step of providing an intermediate layer between

the external jacket and the composite material jacket, using a material that has a thermal expansion coefficient which is between the thermal expansion coefficients of the inner and outer jackets. As further provided in Claim 24, the external jacket comprises a metal material, and the intermediate layer comprises a composite material with a metal matrix. Claim 30 further specifies that the step of providing the intermediate layer includes forming the metal matrix of the intermediate layer using the same metal material contained in the external jacket.

Finally, Claims 27 through 29 define a process for manufacturing an intermediate layer between an internal jacket and an external jacket of a combustion chamber for a rocket drive, which process includes the steps of affixing the fiber structure made of carbon-containing fibers on the internal jacket and depositing a metal material on the fibrous structure with simultaneous infiltration of the metal into the fibrous structure, such that at least one part of the internal jacket or the external jacket is made of a composite material with fibrous structure of carbon-containing fibers. Claim 29 further specifies that the depositing step in Claim 27 includes forming the external jacket itself substantially simultaneously with the infiltration of the fibrous structure with the metal material.

Insofar as Applicants have been able to determine, none of the cited references teaches or suggests the features of the invention as described above.

In particular, the Strasser et al reference is directed to a heat resistant, thermally insulative ductile port liner for the head of an internal combustion engine, having a tube shaped structure formed from at least one layer of fiber reinforced ceramic matrix composite material (FRCMC). One purpose of such a port liner is to retain the residual heat of exhaust gases in the gases themselves, by reducing the thermal flow through the port liner to the engine head and block. (See Column 1, lines 16-19; Column 2, lines 3-7; and Column 2, lines 10-12.)

However, the port liner itself is specified as "having a three-dimensional tube-shaped structure" (Column 3, lines 26-28), as of course it must, nothing contained in Strasser et al teaches or suggests that the FRCMC material has a three-dimensional matrix structure such as described in the specification of the present application and as recited in Claim 11. In particular, Claim 11 recites that the step of producing a ceramic matrix composite material includes forming first, second and third layers of fibers or bundles of fibers, with the fibers of the first layer extending in the a first direction in space, the fibers of the second layer extending in a second direction in space and the fibers of the third layer extending in a third direction of space. In addition, as noted previously, Claim 12 further recites that the formation of the respective layers includes separating the fibers or bundles of fibers of each respective layer, such that in each layer, fibers or bundles of fibers of another layer can be disposed in the resulting

spaces. The latter feature of the invention is also neither taught nor suggested in Strasser et al.

The Haidn et al reference, on the other hand, is directed to a combustion chamber for a rocket engine, which includes inner and outer shells, the outer shell being formed from a fibrous ceramic material and the inner shell being formed from a fibrous ceramic material or from graphite. (Column 2, lines 35-39; Column 3, lines 27-29.) However, while Haidn et al mentions without elaboration that the fiber structure can be built up using three-dimensional weaving and/or braiding techniques (Column 11, lines 51-53), it fails to teach or suggest the specific structure cited in Claim 11, including the orientation of the layers recited therein or the spacing of fibers within the individual layers, as mentioned previously.

In addition, with regard to Claims 23-26, like Strasser et al, Haidn et al also fails to disclose the provision of an intermediate layer between the internal and external jackets, using a material which has a thermal expansion coefficient which is between that of the internal and external jackets, or that the external jacket is formed using a metal material and the intermediate layer is formed of a composite material with a metal matrix as recited in Claim 24, or furthermore that the metal contained in the metal matrix is the same as that contained in the external jacket as recited in Claim 30.

Finally, Haidn et al also fails to suggest a process for manufacturing an intermediate layer between an internal jacket and an external jacket of a combustion chamber for a rocket drive as defined in Claims 27 through 29. In particular, Haidn fails to disclose depositing metal material on the fibrous structure with simultaneous infiltration of the fibrous structure with said metal material, wherein at least one part of the internal or external jacket is made of a composite material with fibrous structure of carbon-containing fibers. Moreover, Haidn et al also does not suggest that the step of depositing a metal material as recited in Claim 27 also includes formation of the external jacket substantially simultaneously with the infiltration of the fibrous structure with the metal material.

Finally, the Tuffias et al patent discloses a refractory composite structure which has a roughened surface that is dendritic in form and produced by chemical vapor deposition techniques. (See Abstract.) In particular, Tuffias et al provides a composite structure 18 which includes a noble metal layer 20 and a refractory metal layer 22 which are bonded metallurgically through an interface 24. The interface 24, in turn, is formed by a gradual transition from one metal, to a mixture of the metals, to the other metal, without discontinuities, as indicated at Column 9, lines 48-51. In contrast to the process defined in Claims 23 through 26, however, Tuffias et al does not suggest the provision of an intermediate layer between internal and external jackets, wherein the thermal

expansion coefficient of the intermediate layer is between that of the external and internal jackets. In fact, on the contrary, Tuffias et al teaches the opposite, in that a separate load-bearing layer 26 is specified as having a linear coefficient of thermal expansion which is less than "that of the bi-metal layers 20, 22 and 24". The latter language strongly suggests that the coefficients of thermal expansion of the three layers 20, 22 and 24 are the same. More importantly, however, Tuffias et al contains no disclosure that teaches the use of an intermediate layer having an expansion coefficient such as recited in Claim 23.

Moreover, Tuffias et al also fails to disclose a method, such as defined in Claims 27 through 29, in which an external jacket is formed on an internal jacket in a single step by depositing a metal layer on the carbon-containing fibrous structure of the internal jacket. Rather, in Tuffias et al, the carbon-containing composite is formed by first preparing a pre-form or construct of carbon fibers, which is subsequently infiltrated by a carbon matrix precursor, such as for example a resin, as described at Column 7, line 66 through Column 8, line 6. Moreover, none of the layers, 32, 20, 24, 22, 28, 30 of Tuffias et al is made of a composite material with fibrous structure of carbon-containing fibers. (See, for example, Column 5, line 38 through Column 10, line 3.) Claim 27, however, requires that at least one part of the internal jacket or the external jacket is made of composite material with fibrous structure of carbon-containing fibers.

In Tuffias et al, an optional oxidation resistant coating (30) may be applied to the exterior of the load-bearing layer (26) if desired. (See Column 9, lines 57-61.) It is apparent that the coating (30) is applied after the production process, and is not an integral part of it. Claim 27 on the other hand, recites a step of depositing a metal material, where the depositing step includes formation of the external jacket, substantially simultaneously with infiltration of the fibrous structure with the metal material. Insofar as the disclosure in Tuffias et al indicates, however, the coating 30 does not appear to be formed substantially simultaneously with the infiltration of the load-bearing layer (26).

In light of the foregoing remarks, this application should be in condition for allowance, and early passage of this case to issue is respectfully requested. If there are any questions regarding this amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and

please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #010739.51198D1).

Respectfully submitted,

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